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Property Rights and the International Organization of Production

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Property Rights and the International Organization of Production

By Pol Antràs*

In recent years, we have witnessed a remarkable increase in the way firms organize production on a global scale. A variety of terms have been used to refer to this phenomenon: the “slicing of the value chain,” “international outsourcing,” “fragmentation of the production process,” “vertical specialization,” “global production sharing,” and many more.

In developing their global sourcing strategies, firms not only decide on where to *locate* the different stages of the value chain, but also on the extent of *control* they want to exert over these processes. The latter is the classical “make-or-buy” decision in industrial organization. Some firms, such as Intel Corporation, decide to keep the production of intermediate inputs within firm boundaries, thus engaging in foreign direct investment (FDI) and intrafirm trade when the integrated supplier is in a foreign country. Other firms, such as Nike, choose to contract with arm’s-length suppliers for the procurement of these inputs, and thus their activities are in general not recorded in FDI or intrafirm trade statistics.

The issue of internalization or control is crucial for gaining an understanding of multinational firms.¹ Yet, most previous theories of the multinational firm draw their boundaries appealing to technological considerations, such as economies of scale or transport costs.² In the three chapters of my 2003 M.I.T. Ph.D. thesis, I instead set forth a purely organizational, property-rights model of the multinational firm.³

I build on the work of Sanford J. Grossman and Oliver D. Hart (1986), who put forth the idea that ownership of physical assets is a source of power when contracts are incomplete. In particular, in situations in which parties encounter contingencies that were not foreseen in an initial contract, the agent enjoying property rights over the physical assets involved in production has the right to decide on the use of these assets. The asset owner thus enjoys residual rights of control, or residual powers, and this has a critical effect on how the surplus ends up being divided between the parties.

Grossman and Hart show that in the presence of relationship-specific investments, these considerations lead to a well-defined theory of the boundaries of the firm in which both the benefits and the costs of integration are endogenous. By affecting the ex-post division of surplus, the allocation

of residual rights has a critical effect on each party's ex-ante incentives to invest, which in turn determine the size of the surplus to be divided. A salient result of their analysis, and one that will be exploited below, is that ex-ante efficiency dictates that residual rights of control should be assigned to the party whose investment contributes most to the value of the relationship.

This paper attempts to provide an overview of how one can combine the insights from the property-rights approach with the apparatus of international trade theory to study the location and control decisions of the multinational firm in a unified framework.

I. A Simple Model of Firm Behavior

Let us consider first a simple partial-equilibrium model in which a final-good producer decides how to organize production of a particular good taking as given the behavior of other producers.

Consumer preferences are such that the unique producer of good y faces demand given by

$$y = \lambda p^{-1/(1-\alpha)}, \quad 0 < \alpha < 1, \quad (1)$$

where p is the price of the good and λ is a parameter that the producer takes as given.

Production of good y requires the development of two specialized intermediate inputs h and m . Output is a Cobb-Douglas function of these inputs

$$y = \left(\frac{h}{\eta}\right)^\eta \left(\frac{m}{1-\eta}\right)^{1-\eta}, \quad 0 < \eta < 1, \quad (2)$$

where a higher η is associated with a more intensive use of h in production.

There are two agents engaged in production: a final-good producer (denoted by H) who supplies the input h and produces the final good y , and an operator of a manufacturing plant (denoted by M) who supplies the input m . Agent H can produce h at a constant marginal cost c_h , while agent M can produce m at a constant marginal cost c_m . In addition, production requires a fixed cost equal to $f \cdot g(c_h, c_m)$, where the function g is nondecreasing in its arguments. Both inputs are tailored specifically to the needs of the other party in the transaction and, for simplicity, they are assumed to be useless outside this particular relationship.

I consider first a closed-economy version of the model where final-good producers can only source from their home country. In terms of the discussion in the introduction, I thus initially focus

on the control decision and abstract from the locational decision. Henceforth, a subscript V will be associated with vertical integration and a subscript O with outsourcing.

Following Grossman and Hart (1986), contracts are incomplete in the sense that the only contractibles *ex-ante* (i.e., before the inputs have been produced) are the allocation of residual rights (i.e., the ownership structure) and a lump-sum transfer between the two parties. In particular, contracts specifying the purchase of a certain type of intermediate input for a certain price are not enforceable.⁴ As a result, H and M can only bargain over the surplus from the relationship after the inputs have been produced. This *ex-post* bargaining is modelled as a generalized Nash bargaining game in which H obtains a fraction $\beta \in (0,1)$ of the *ex-post* gains from trade. Conversely, it is assumed that, *ex-ante*, H faces a perfectly elastic supply of potential M agents so that, in equilibrium, the initial transfer will be such that it secures the participation of M in the relationship at minimum cost to H .

Following the property-rights approach to the theory of the firm and contrary to the Coase-Williamson approach, it is assumed that ex-post bargaining takes place both under outsourcing and under integration. The distribution of surplus, however, is sensitive to the mode of organization because the outside option of H is naturally higher when it owns the manufacturing plant than when it does not. To see this, notice that under outsourcing a contractual breach leaves both agents with a zero payoff because the inputs are useless unless combined together. Instead, when H integrates the production of m , it effectively purchases the residual rights of control over this input. Consequently, if M refuses to trade after the sunk costs have been incurred, H now has the option of firing M and seizing the amount of m already produced. To ensure positive ex-post gains from trade, it is assumed, however, that H cannot use the input without M as effectively as it can with the cooperation of M , so firing M results in a loss of a fraction δ of final-good production.

In light of equations (1) and (2), the potential revenue from the sale of y is given by

$$R(h, m) = \lambda^{1-\alpha} \left(\frac{h}{\eta} \right)^{\alpha\eta} \left(\frac{m}{1-\eta} \right)^{\alpha(1-\eta)}. \quad (3)$$

Given the specification of the ex-post bargaining, H obtains a fraction $\beta_O = \beta$ of sale revenue under outsourcing and a fraction $\beta_V = \delta^\alpha + \beta(1 - \delta^\alpha) > \beta_O$ under integration. It is straightforward to show that the optimal ownership structure k^* is thus the solution to the following program:

$$\begin{aligned}
\max_{k \in \{V, O\}} \quad & \pi_k = R(h_k, m_k) - c_h \cdot h_k - c_m \cdot m_k - f \cdot g(c_h, c_m) - \overline{U} \\
s.t. \quad & h_k = \arg \max_h \{\beta_k R(h, m_k) - c_h \cdot h\} \\
& m_k = \arg \max_m \{(1 - \beta_k) R(h_k, m) - c_m \cdot m\}
\end{aligned} \tag{P1}$$

where $R(\cdot)$ is given in (3) and \overline{U} is the outside option of the operator M . Notice that the first-best level of investments would be such that π_k is maximized. As is clear from the program (P1), relative to the first best, incomplete contracting introduces two constraints that necessarily lead to underprovision of both h and m . This is due to the classical lock-in effect by which the threat of contractual breach makes producers perceive only a fraction of the marginal return to their relationship-specific investments. The solution to the constrained program (P1) delivers the following result (see Antràs, 2003 for details):

Proposition 1 *There exists a unique threshold $\hat{\eta} \in (0, 1)$ such that for all $\eta > \hat{\eta}$, integration dominates outsourcing ($k^* = V$), while for all $\eta < \hat{\eta}$, outsourcing dominates integration ($k^* = O$).*

The logic of this result lies at the heart of Grossman and Hart's (1986) seminal contribution. In a world of incomplete contracts, ex-ante efficiency dictates that residual rights should be controlled by the party undertaking a relatively more important investment. If production is very intensive in the m input, the investment made by the final-good producer will have a relatively low marginal product, and it will thus be optimal to assign the residual rights of control to the operator so as to alleviate the underinvestment in the provision of the m input. Conversely, when production is intensive in the h input, H will optimally choose to tilt the bargaining power in its favor by obtaining these residual rights, thus giving rise to vertical integration.

Consider now a two-country version of the model in which firms are allowed to locate different parts of the production process in either 'the North' or 'the South'. The production process we described above entails three stages (production of h , m , and y), thus giving rise to several potential locational decisions. Let us denote by L the set of possible locational decisions and by $\ell \in L$ a particular one. For example, ℓ could entail production of h and y in the North and of m in the South. I will explore several possibilities below. Notice that different locational choices will in general entail different values of key parameters. In particular, transport costs and cross-country differences in factor prices and in institutions imply that different locational choices will

be associated with different values for the parameters c_h , c_m , f , \overline{U} , β_O , and β_V , as well as for the functions $R(\cdot)$ and $g(\cdot)$. Furthermore, as argued in Antràs and Helpman (2004), it is also natural to allow the fixed cost parameter f to depend on the ownership structure k .

How do these generalizations affect the way firms organize production? The optimal ownership structure k^* and the optimal locational choice ℓ^* now solve the following program:

$$\begin{aligned} \max_{k \in \{V, O\}, \ell \in L} \quad & \pi_k^\ell = R^\ell(h_k^\ell, m_k^\ell) - c_h^\ell \cdot h_k^\ell - c_m^\ell \cdot m_k^\ell - f_k^\ell \cdot g^\ell(c_h^\ell, c_m^\ell) - \overline{U}^\ell \\ \text{s.t.} \quad & h_k^\ell = \arg \max_h \left\{ \beta_k^\ell R^\ell(h, m_k^\ell) - c_h^\ell \cdot h \right\} \\ & m_k^\ell = \arg \max_m \left\{ (1 - \beta_k^\ell) R^\ell(h_k^\ell, m) - c_m^\ell \cdot m \right\} \end{aligned} \quad (\text{P2})$$

The general program in (P2) is the basis for the three applications of the property-rights approach discussed in the next three sections.

1 II. A World Equilibrium with Homogenous Firms

In Antràs (2003), I apply the property-rights approach to explain two systematic patterns in the intrafirm component of U.S. trade. In particular, I document that: (i) across industries, the share of intrafirm imports in total U.S. imports is higher, the higher the capital intensity of the exporting industry, and (ii) across countries, the share of intrafirm imports in total U.S. imports is higher, the higher the capital-labor ratio of the exporting country.

Let us consider a simple variant version of the model in Antràs (2003). Consumers spend a constant share of income on differentiated varieties in two sectors Y and Z . Identical Dixit-Stiglitz subutility functions in both sectors give rise to a demand function for a particular variety of the form in (1), with λ being sector-specific. Preferences are identical in both countries.

Production of differentiated varieties is as described in the previous section with the additional assumption that the inputs h and m are nontradable. I assume, however, that agent M can produce an intermediate input that combines h and m and that is tradable at zero cost. This composite input is produced according to (2), where the elasticity of output with respect to h is higher in sector Y than in sector Z , i.e., $\eta_Y > \eta_Z$. The final-good is produced in the North using this intermediate input and no additional factors. Notice that these assumptions imply that the locational choice simply consists in choosing whether h and m are combined in the North or in the South. Hence,

$\ell \in \{N, S\}$. The ownership structure decision is as described above, with the additional simplifying assumption that β_k^ℓ is independent of ℓ , so that contractual frictions are identical in both domestic and international transactions. It is further assumed that the bargaining parameters β and δ are identical in both sectors. The *ex-ante* outside option is normalized to zero, $\bar{U}^\ell = 0$.

On the cost structure, it is assumed that h is capital-intensive relative to m . Because h needs to be produced in the same location where m is produced, this can be interpreted as H contributing to the physical capital investments of M , e.g., financing the construction of a production facility.⁵ For simplicity, I assume extreme factor intensity so that $c_h^\ell = r^\ell$ and $c_m^\ell = w^\ell$, where r^ℓ and w^ℓ denote the rental and wage rates in country ℓ . It is also convenient to assume that fixed costs have the same factor intensity as variable costs (i.e., $g_j^\ell(r^\ell, w^\ell) = (r^\ell)^{\eta_j} (w^\ell)^{1-\eta_j}$ for $j = Y, Z$) and that f_k^ℓ is independent of ownership structure and location.

It is straightforward to show that under these assumptions the ownership structure and locational decisions in (P2) can be analyzed separately. Furthermore, the optimal ownership structure in sector $j \in \{Y, Z\}$ solves (P1), while the optimal location decision solves $\min_\ell \left\{ (r^\ell)^{\eta_j} (w^\ell)^{1-\eta_j} \right\}$. This implies that Proposition 1 applies and all producers in sector j will engage in vertical integration if $\eta_j > \hat{\eta}$, and in outsourcing if $\eta_j < \hat{\eta}$. It thus follows that assuming $\eta_Y > \hat{\eta} > \eta_Z$, all Northern imports in sector Y will be transacted within firm boundaries, while all Northern imports in sector Z will be transacted at arm's length. This result provides a rationale for the positive correlation between capital intensity and intrafirm trade mentioned at the beginning of this section.

In Antràs (2003) I solve for the full general equilibrium of the model in which free entry drives profits down to zero, factor markets clear in both countries, and world income equals world spending. If the South is capital-scarce relative to the North but relative factor endowment differences are not too large, then international trade will bring about factor price equalization, in which case factor market clearing in the South will require that the South produces a disproportionate share of the world output in the labor-intensive sector Z . Furthermore, the lower is the capital-labor ratio in the South, the lower will be the share of sector- Y imports in total Northern imports from the South. Coupling this prediction with the fact that only in sector Y are imports transacted within firm boundaries immediately delivers a positive correlation between the capital-labor ratio in the South and the share of intrafirm imports in total Northern imports. This is the second systematic pattern mentioned above. More details on the derivations of these results can be found in Antràs (2003), where a multi-country version of the model is developed and where the correlations that

motivate the theoretical model are shown to be robust to the inclusion of several industry and country characteristics.

III. A World Equilibrium with Heterogeneous Firms

An implication of the previous model with homogenous firms is that an industry's share of intrafirm trade in total trade should be either 100 percent or zero. In Antràs (2003), I instead unveil a smooth positive relationship between the share of intrafirm imports in total U.S. imports and both capital intensity and R&D intensity. To reconcile theory and evidence I appeal to a mismatch between what an industry is to the statistician relative to what it is to the representative consumer. A much more satisfactory approach is to appropriately model intraindustry heterogeneity and to identify firm-level characteristics that might affect the internal organization of firms. This is the approach in Antràs and Helpman (2004), where we incorporate intraindustry heterogeneity of the Melitz (2003) type in a property-rights model of the multinational firm. In the remainder of this section I describe a simplified version of the Antràs and Helpman (2004) model.

Consumers in both countries demand the output of one homogenous-good sector and J differentiated-good sectors. Preferences are quasilinear in the homogenous good and feature a constant elasticity of substitution between differentiated varieties within a sector and also between varieties in different sectors (the latter elasticity is assumed higher). This preference structure delivers a demand function for a particular variety in industry j that is analogous to (1), where λ is sector specific and is a function of the aggregate consumption in the sector.

Firm behavior is a variant of the general program (P2). It is again assumed that the final good y is always produced in the North. The intermediate inputs h and m are now tradable, but it is assumed that h (which we associate with headquarters services) is only produced in the North. The location decision thus reduces to the choice of where to produce m (which we think of as manufactured components). Hence, again $\ell \in \{N, S\}$, but note that N and S have a different interpretation from that above. To simplify matters, we again abstract from institutional differences across countries and sectors and assume that the bargaining weights β_k^ℓ are independent of ℓ and j .⁶ The *ex-ante* outside option is again normalized to zero, $\bar{U}^\ell = 0$.

Producers in each country face a perfectly elastic supply of the unique factor of production, labor. These wage rates are fixed and we assume that $w^N > w^S$. The final good is produced

according to $\tilde{y} = \theta y$, where y is given in (2) and the productivity parameter θ is firm specific and drawn from a Pareto distribution with shape z , i.e., $G(\theta) = 1 - (b/\theta)^z$ for $\theta \geq b > 0$.⁷ The elasticity of output with respect to h is common to all firms within a sector, but varies across sectors. Production of intermediate inputs requires unit of labor per unit of output in the country where they are produced. The international shipment of components is costly and τ units of m need to be shipped from the South for one unit to arrive to the North. Provided that this transport cost is low enough, our assumptions imply that $c_h^N = c_m^N = w^N > \tau w^S = c_m^S$.

There are also different types of fixed costs of production, which are all defined in terms of Northern labor (i.e., $g^N(\cdot) = g^S(\cdot) = w^N$). First, H needs to incur a fixed cost f_E of entry, upon which the productivity parameter θ is revealed to him or her. If H decides to remain in the market, additional fixed organizational costs need to be incurred. As discussed in Antràs and Helpman (2004), these fixed organizational costs are likely to vary depending on whether m is sourced in the North or in the South, and on whether it is insourced or outsourced. In particular, a natural ranking of these fixed costs is

$$f_V^S > f_O^S > f_V^N > f_O^N.$$

In words, fixed organizational costs are higher when M is located in the South regardless of ownership structure, and given the location of M , the fixed organizational costs are higher when M is integrated than when it is not.

With this setup, the choice of an organizational form faces two types of tensions. In terms of the location decision, the South entails relatively lower variable costs, but relatively higher fixed costs. As in the work of Melitz (2003), it is clear that the firm-specific productivity parameter θ will crucially affect the firm's participation in international trade. In terms of the integration decision, integration improves efficiency of variable production when the intensity of headquarter services is high (see Proposition 1 above), but involves higher fixed costs. This integration decision will thus crucially depend on both η and θ .

In Antràs and Helpman (2004), we show that equilibria featuring multiple organizational forms within an industry can easily be constructed. In particular, in our benchmark headquarter-intensive sector, the least productive firms exit the market upon observing their productivity, and four non-empty (and connected) subsets of the remaining firms choose each of the four possible organizational forms. The most productive firms in the North engage in foreign insourcing (or FDI in the South),

the next most productive firms undertake foreign outsourcing, the next subset insource domestically, and the least productive firms among the surviving ones outsource domestically.

We also use the model to study the determinants of the relative prevalence of these different organizational forms. The predictions we obtain move well beyond those derived in Antràs (2003) and open the door for more careful empirical studies of the characteristics of the international organization of production. In particular, the model predicts that, in a cross-section of industries, the share of intrafirm imports of components in total imports of components should be higher in industries with higher headquarter intensity (higher η), higher productivity dispersion (lower z), and higher transport costs (higher τ). Furthermore, the same applies for a comparison between domestic insourcing and domestic outsourcing. We also find that increasing wage differences between the North and the South or falling international trade costs increase the amount of international sourcing, but also increase the share of foreign outsourcing in total foreign sourcing and the share of domestic outsourcing in total domestic sourcing. We argue that these predictions are consistent with broad patterns in the data.

IV. Differences in Contract Enforceability and Product Cycles

A maintained assumption in the previous sections was that the degree of enforceability of contracts was identical in both countries, in the sense that contracts featured the same level of incompleteness independently of where the agents involved in the transaction reside. In Antràs (2005), I explore the more plausible scenario in which contracts governing international transactions are relatively less enforceable than contracts governing domestic transactions.⁸

The structure of the model is very similar to that in section III. In particular, h and y are always produced in the North, so the location decision consists on where to source m , while the ownership decision consists on whether to integrate M or not. Labor is the unique factor of production. The model is simpler in that all firms within an industry are identical ($\theta = 1$ for all firms), fixed costs are independent of location and ownership structure, and transport costs are zero. The main innovation in the modeling of firm behavior is that when $\ell = N$, that is when domestic sourcing is chosen, contracts specifying the purchase of a particular intermediate input for a given price are fully enforceable. This is shown to be identical to solving the problem in (P2), but with the two constraints being operative only when $\ell = S$. To avoid technical complications, it is also assumed

that $\beta_V^S \leq 3/4$ (this assumption is relaxed in the Appendix of the original paper). Given this setup, in Antràs (2005) I prove formally that:

Proposition 2 *If the relative wage w^N/w^S is sufficiently high, there exist two thresholds $\bar{\eta}$ and $\underline{\eta}$ with $\bar{\eta} \geq \underline{\eta}$ such that: (i) if $\eta > \bar{\eta}$, it is optimal to produce input m in the North; (ii) if $\bar{\eta} > \eta > \underline{\eta}$, it is optimal to assign the production of m to an integrated supplier in the South, and (iii) if $\eta < \underline{\eta}$, it is optimal to assign the production of m to a nonintegrated supplier in the South.*

To understand this result, notice that in choosing between domestic and foreign sourcing, the Northern manager H faces a trade-off between the lower costs of Southern components and the higher incomplete-contracting distortions associated with it. When headquarter intensity η is high, sourcing in the South is very unattractive because it bears the full cost of incomplete contracting (which affects both the h and m inputs) with little benefit from the lower wage in the South (which only affects the m input). On the other hand, when components have a sufficiently large marginal product, the lower wage in the South has a sufficiently large effect on profits to offset the incomplete-contracting distortions. Because transactions in the North are governed by complete contracts, ownership structure in Northern sourcing is both indeterminate and irrelevant. In contrast, when Southern sourcing is chosen ($\eta < \bar{\eta}$), the assignment of residual rights is much more interesting and conforms to the results in the previous sections. In particular, there exists a threshold headquarter intensity over (under) which Southern insourcing dominates (is dominated by) Southern outsourcing.

In Antràs (2005), I use these results to develop a new version of Vernon's (1966) product cycle hypothesis. I model the continuous standardization of goods along their life cycle as a gradual fall in η . Intuitively, relative to product development, marketing, and other services provided by the headquarters H , the mere assembly of a product becomes a more significant input in production as the good matures and its production technique becomes standardized. A corollary of Proposition 2 is then that the model features a three-stage product cycle. Because of contractual frictions, goods are initially manufactured in the same country where product development takes place. When the good becomes sufficiently standardized, the manufacturing stage of production shifts to a low-wage foreign location, but this transfer occurs first within firm boundaries, and only at a later stage to independent foreign firms. In the paper, I discuss several cross-sectional and time-series implications of the model and relate them to the empirical literature on the product cycle.

In Antràs (2005), I also develop a simple general-equilibrium extension of the model, in which the relative wage w^N/w^S is endogenously pinned down. A salient feature of the analysis is that as long as contracts governing international transactions are incomplete, the *equilibrium* wage in the North necessarily exceeds that in the South.⁹

V. Conclusions

The models developed above have generated a rich set of predictions regarding the way firms organize production across borders. They should thus provide some guidance for future empirical studies on this important topic. A limitation of the above analysis has been the focus on only two decisions (location and control) of multinational firms. Future efforts should be directed at incorporating additional dimensions of organizational economics into the study of the international organization of production.

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Notes

¹Richard E. Caves (1996, p. 1) defines a multinational firm as “an enterprise that *controls* and manages production establishments – plants – located in at least two countries.”

²This previous literature builds on the seminal work of Elhanan Helpman (1984) and James R. Markusen (1984).

³The internalization decision of multinational firms has also been studied, among others, by Wilfred J. Ethier (1986), Ethier and Markusen (1996), John E. McLaren (2000), and Gene M. Grossman and Helpman (2002, 2004). These authors focus on modeling the costs of arm’s-length transacting stemming from informational asymmetries, knowledge dissipation, contractual frictions, and costly search. In none of these approaches is the internalization decision related to the allocation of some residual rights of control. An important caveat of these previous approaches is that they shed little light on the costs of internalization.

⁴This would naturally be the case if agents could choose the quality of inputs but a court of law could not verify it (see Grossman and Helpman, 2002, and Antràs, 2003, for more details).

⁵In Antràs (2003), I present evidence suggesting that cost-sharing in physical capital investments is quite common.

⁶In Antràs and Helpman (2004), we consider the case in which $\delta^N > \delta^S$ and thus $\beta_V^N > \beta_V^S$. We interpret this assumption as reflecting better legal protection in the North.

⁷The parameter z is assumed large enough to ensure a finite variance of the size distribution of firms.

⁸In Antràs and Helpman (2004) we consider institutional differences across countries that affect the ex-post division of surplus *for a given level* of contractual incompleteness (see footnote 6 above).

⁹Another appealing characteristic of the general-equilibrium analysis is that the cross-sectional picture that emerges from the model is very similar to that in the classical Ricardian model with a continuum of goods of Rudiger Dornbusch et al. (1977), with the novelty that comparative advantage arises endogenously from a combination of the Northern productivity advantage in product development, the continuous standardization of goods, and the incompleteness of contracts.